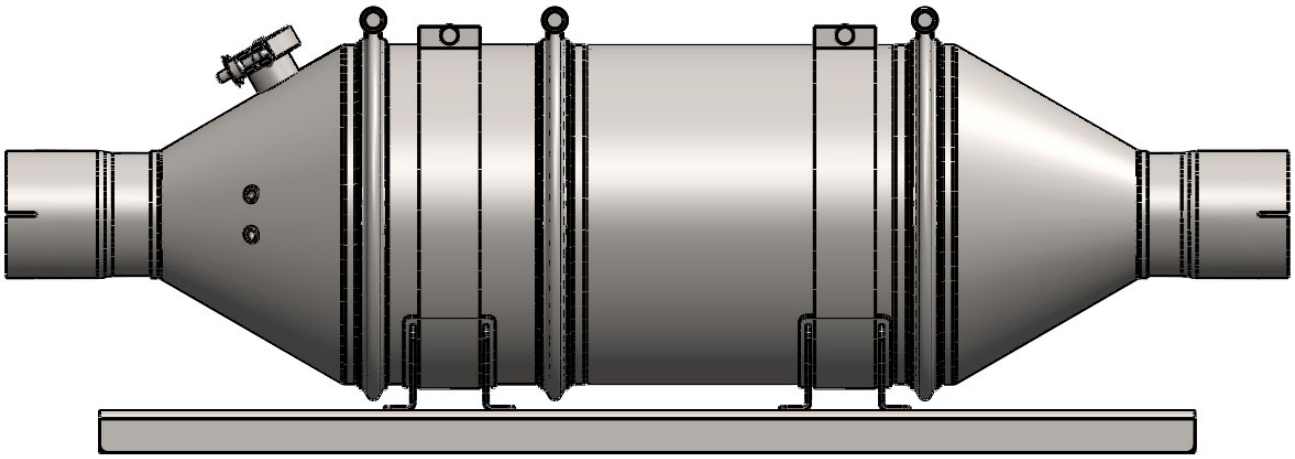
LongMile®-S

Owner's Manual



ASSEMBLED IN USA

The instructions, specifications, and recommendations in this manual are based on current information when this manual was released. ESW CleanTech, Inc. reserves the right to make changes at any time without obligation. If you find differences between your system and the information in this manual, contact your ESW CleanTech distributor or call ESW CleanTech at 1-800-398-6105.

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ESW CleanTech, Inc. LongMile-S Owner's Manual

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GENERAL INFORMATION

Cautions

Please study this manual and understand the requirements for the ESW CleanTech LongMile-S system before operating your vehicle.

Do not idle for more than 5 minutes in a row. If the engine has been idling for more than 5 minutes, turn it off. (In some states it is illegal to idle for more than 5 minutes.) Long idle times could lead to an excessive build up of soot which could later lead to damage of the system under certain operating conditions. Damage to the system caused by excessive idle could be the basis for denying a warranty claim.

The pictures and descriptions in this manual are for a typical LongMile-S system. Some parts, components and configurations for your particular system may vary from those shown here depending on the engine and application.

The use of parts which are materially different than the verified retrofit parts or systems may void the verification and the warranty.

The owner's obligations, routine observations and periodic maintenance requirements are described in this manual. Contact an ESW CleanTech authorized distributor if you need further assistance.

Safety Warnings

- **The LongMile-S stays hotter longer than a stock muffler will after operating under heavy load and after the engine is turned off. All surfaces could be hot and may cause burns.**

- **After operating under heavy load, be very careful about operating or idling near any combustible material such as dry grass or trash. The LongMile-S retains heat longer than a muffler will, which makes it possible for very hot exhaust gases to exit the tailpipe for several minutes and be a potential source of ignition for combustible material.**

- **Do not allow combustible material from the working environment to come in contact with the LongMile-S (for example, paper, trash, sawdust).**

Owner's Legal Obligations

Use of any alternative diesel fuels and or fuel additives not specifically listed in the CARB verification Executive Order (E.O.) is illegal and strictly prohibited. Operating with an unapproved alternative diesel fuel or fuel additive violates the E.O., negates the verification for that engine, and removes compliance status for the vehicle. The end-user must meet other requirements in the E.O. for the LongMile-S which is provided in this manual beginning on

page 30. The E.O. for the LongMile-S may also be obtained from the CARB website at http://www.arb.ca.gov/diesel/verdev/vt/cvt.htm.

The installation of the LongMile-S is based on the owner's understanding that adding a new part to or altering an original part of a certified configuration could be considered a violation of the tampering prohibition of the Clean Air Act. The owner understands that the installation of the LongMile-S will not violate tampering provisions of the Act, at the time of installation, because of the testing performed under the verification process—provided that the owner adheres to all installation instructions and meets all operating and maintenance requirements for the LongMile-S.

- **Specific events that require action by the owner or operator are given in the "Owner's Obligations" section on page 25.**
- **If any of these events occur, it is the owner's obligation to take the appropriate action. Failure to do so may be the basis for denying a warranty claim.**

Contact Information

Contact an ESW CleanTech authorized distributor for any sales or service support for your LongMile-S system. The tables below for contact information are provided for the customer to complete at their convenience. For more information, contact your local ESW CleanTech product support representative, call ESW CleanTech at 1-800-398-6105, or visit www.eswgroup.com.

Distributor	
Address	
Contact person	
Contact person's phone	
Contact person's fax	
Contact person's email	

Name of local ESW CleanTech product support representative	
Local ESW CleanTech representative's phone	
Local ESW CleanTech representative's email	

Installation

ESW CleanTech recommends that an ESW CleanTech authorized technician installs the LongMile-S system. The complete installation procedures are described in the LongMile-S Installation Manual. Copies of the manual are available upon request from your distributor. The installation warranty (page 29) is the responsibility of the distributor that installs the LongMile-S system.

Attention:

A ESW CleanTech certified technician must commission the system;
otherwise, that may be the basis for denying a warranty claim.
Warranty registration is submitted by the ESW CleanTech authorized distributor.

Engine Repower

A DECS installed on a vehicle that is repowered may remain installed provided:

- The replacement engine meets all the terms and conditions of the governing Executive Order or conditional verification letter,
- The DECS is not more than ten years old (based on the date of manufacture), and
- The appropriate DECS engine label is affixed to the replacement engine in a visible location.

Acronyms

BP	Backpressure
CARB	California Air Resources Board
CO	Carbon monoxide
DECS	Diesel emissions control system
DOC	Diesel oxidation catalyst
DPF	Diesel particulate filter
HC	Hydrocarbons
LED	Light emitting diode (driver notification light)
MLC®	The electronic controller in the LongMile-S system
MLinC	The software program used to communicate with the MLC
OEM	Original equipment manufacturer
PM	Particulate matter (diesel soot)
TC	Thermocouple
ULSD	Ultra-low sulfur diesel fuel
VDC	Volts direct current

LONGMILE-S SYSTEM DESCRIPTION

Product Summary

The LongMile-S has been verified by the California Air Resources Board to capture over 85% of the particulate matter (PM) from diesel engine exhaust ("Level 3 plus"). Features include:

- Stainless steel construction
- Rugged silicon carbide diesel particulate filter (DPF)
- Modular design to facilitate installation, service and maintenance
- Passive regeneration
- ESW CleanTech MLC (the system controller)
- Sound attenuation eliminating the need for a muffler or silencer (even if that muffler or silencer contains an oxidation catalyst)

The LongMile-S (Figure 1) consists of the PM filter assembly and the control system:

- The DPF captures over 85% of the particulate matter (soot) from the diesel engine exhaust while the engine is operating.
- The DOC enables regeneration of the DPF when the engine is operating under load.
- The control system monitors the LongMile-S and engine during operation. The control system also alerts the operator if action or service is required.

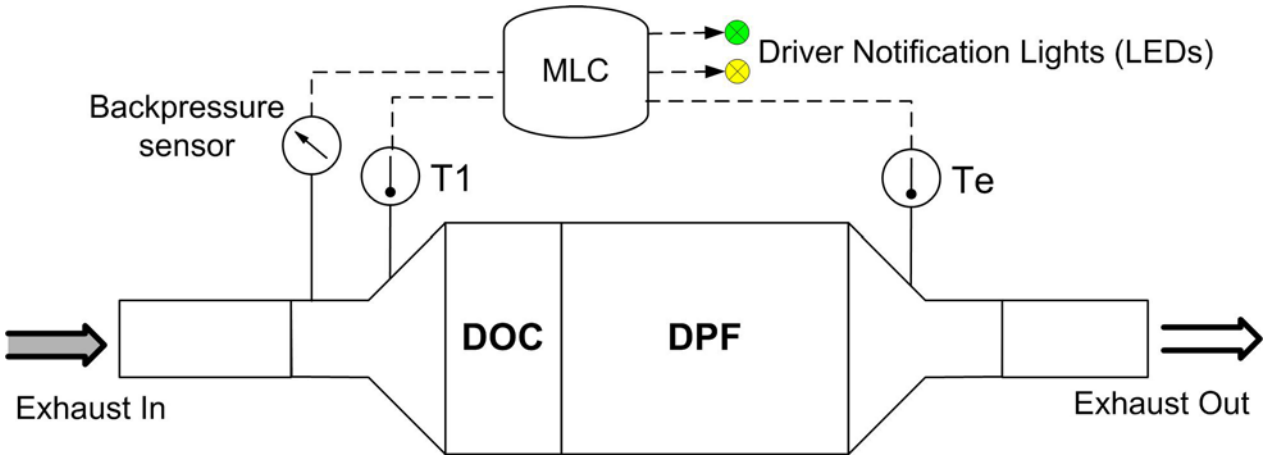


Figure 1: LongMile-S system schematic drawing.

PM Filter Assembly

The PM filter assembly (Figure 2) is the core of the LongMile-S system and it usually will replace the muffler. The assembly has important features listed below:

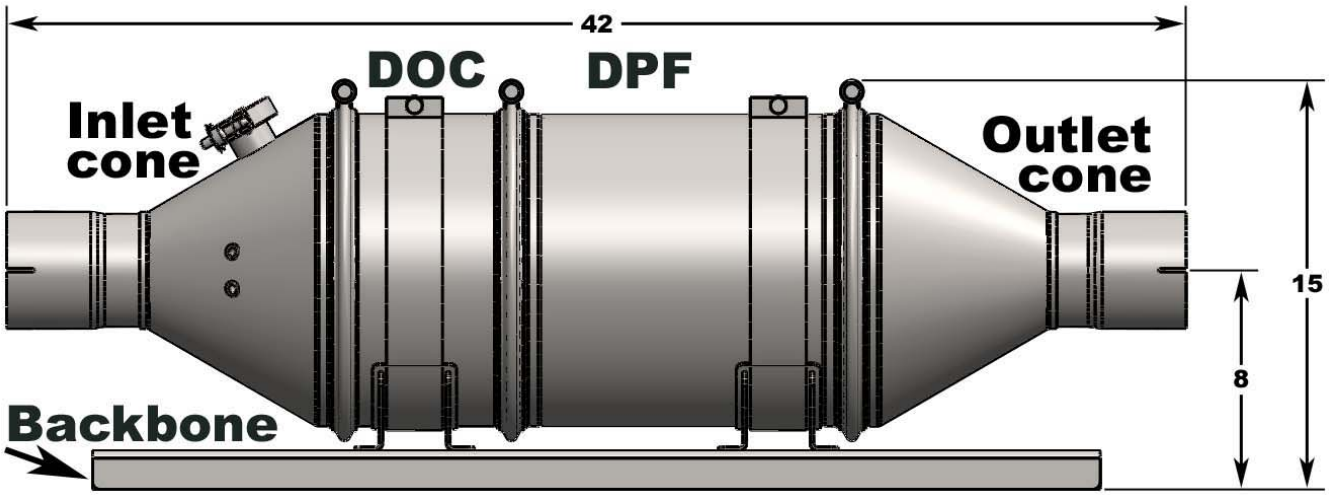


Figure 2: PM filter assembly of typical LongMile-S system (dimensions in inches).

ESW CleanTech provides a mounting assembly specifically designed for the LongMile-S. **Although the PM filter assembly replaces the stock muffler, it is important to note that the PM filter assembly is heavier than a typical muffler.**

The PM filter assembly requires the following care and handling:

1. Do not drop or hammer.
2. Use appropriate equipment when lifting.
3. Protect from water intrusion.
4. Protect from accidental impacts.
5. Do not weld.
6. Protect flanges during transport (use the foam shipping covers).

Attention:
Handle with care!

LongMile-S system configuration with respect to engine horsepower

Depending on the engine horsepower, the verified LongMile-S system configuration is shown in the table below.

Verified LongMile-S Configurations* and Engine Horsepower

DOC Part Number	DPF Part Number	HP Range
CJD-27-10 or CJDA-27-10 or CJD-35-10	CJF-___ or CKF-___	175-300
CJD-20-10 or CJDA-20-10	CJF-___ or CKF-___	275-350
	CNF-___	275-400
	CPF-___	300-450
CKD-33-10	CNF-___	350-450
	CPF-___	400-500

*Note, ESW CleanTech reserves the right to limit part use where the ranges overlap.

The PM filter assembly creates backpressure on the engine

In the process of removing over 85% of the soot and ash from the exhaust, the LongMile-S creates backpressure on the engine. At times, the backpressure from the LongMile-S system may be higher than the backpressure caused by a muffler. The actual amount of backpressure from the LongMile-S varies instantaneously depending on the engine speed and load and the soot and ash loading in the DPF. Passive regeneration removes the carbonaceous part of the soot and thereby lowers the backpressure.

Control System

The MLC and some electrical components are housed in the Controls Box. The MLC monitors the LongMile-S when the engine is operating. The MLC also continually logs operating data and records instances of unusual conditions.

The MLC controls the driver notification lights (sometimes called the LEDs). The meaning of each light and the appropriate actions for the driver or operator to take are described in the "Operations" section of this manual starting on page 10.

CARB-Verification Labels

The LongMile-S is provided with two CARB-verification labels. One is installed on the engine (Figure 3) and the other one is attached to the wiring harness at the LongMile-S's Controls Box (Figure 4). If either one is missing, order a replacement label from an ESW CleanTech authorized distributor and be sure to order the correct label for your application (see the table below the pictures).

Figure 3: Example of CARB-verification label installed on engine.

Figure 4: CARB-verification label attached to wiring harness at Controls Box.

Product	Application	Verification Family Name	Label Part Number
LongMile-S	On-road	CA/ECT/2012/PM3+/N00/ON/DPF01	CUH-2001-1K

OPERATIONS

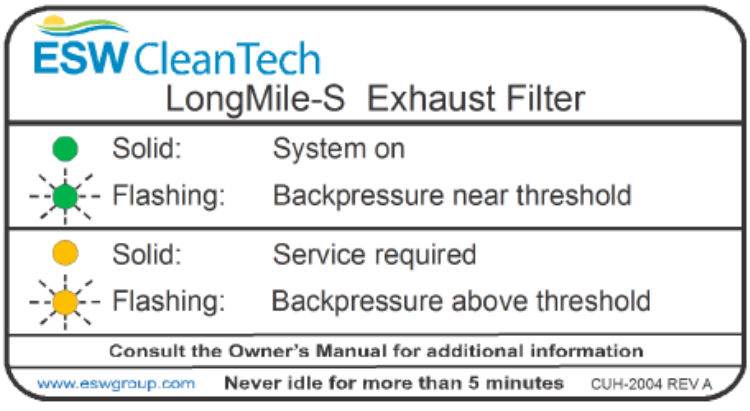
Pay Attention to the System, Engine and Vehicle

The owner or operator should observe the LongMile-S, engine and vehicle's operation on a regular basis. See the "Driver Notification Lights" section below for a detailed description of each light's meaning and the appropriate response. Use the Troubleshooting Table (page 20) if you suspect the engine or LongMile-S are not operating properly. Contact an ESW CleanTech authorized distributor (or a properly trained technician under the owner's control) when needed.

1. Do not idle for more than 5 minutes in a row. If the engine has been idling for more than 5 minutes, turn it off. (In some states it is illegal to idle for more than 5 minutes.)
2. The operator should observe the green and amber lights regularly while operating the vehicle and respond accordingly.
3. During engine operation, there should not be soot emissions from the LongMile-S clamps or tailpipe. Notify an ESW CleanTech authorized distributor (or the owner's technician) if any unusual exhaust emissions are observed.
4. Periodically inspect the exhaust system for integrity. Note anything abnormal and make repairs as warranted. For vertical exhaust stacks, **make sure the turn out stack or rain cap is in place** and functioning properly. Contact an ESW CleanTech authorized distributor as needed.

Driver Notification Lights

The operator must observe the LongMile-S driver notification lights on a regular basis and respond accordingly. Failure to adhere to these instructions could result in damage or failure to the LongMile-S system.



The label placed next to the lights (Figure 5) provides a brief description of each light's meaning.

The light meanings are summarized in the table below (and are explained further after the table).

Figure 5: Label for driver notification lights (LEDs).

Attention: The amber light will turn on solid for a few seconds after the engine starts and is first put under load. This confirms that the amber light is working.

Light Status	Meaning	Required Action or Response
Green light: On solid Amber light: Off	MLC® is on and the LongMile-S is operational	**Check the state of the lights regularly.**
Green light: Off Amber light: Off	LongMile-S needs service	**Do not operate the vehicle.** Check the fuse in the MLC power wire or see if the wire is disconnected or cut. Low battery voltage may also be a cause. Check the battery voltage. If the fuse or battery is not the problem, contact an ESW CleanTech distributor to arrange for service by an ESW CleanTech authorized technician.
Green light: Off Amber light: On solid	LongMile-S needs service	**Do not operate the vehicle.** Low battery voltage may be a cause. Check the battery voltage. If the battery is not the problem, contact an ESW CleanTech distributor to arrange for service by an ESW CleanTech authorized technician.
Green light: Flashing Amber light: Off	System is operating near its backpressure threshold	**Reduce the engine load if possible.** If the light stops flashing, resume normal operation. If the system has been installed for less than one month, contact an ESW CleanTech distributor. See the "Green Light Flashing" discussion below for further information.
Green light: On solid or Flashing Amber light: Flashing	System is operating above its backpressure threshold	**Reduce the engine load if possible.** If the lights stop flashing, resume normal operation. If the system has been installed for less than one month, contact an ESW CleanTech distributor. See the "Amber Light Flashing" discussion below for further information.
Green light: On solid or Flashing Amber light: On solid	LongMile-S needs service	**Service required.** Contact a ESW CleanTech distributor to arrange for service by an ESW CleanTech authorized technician. Operator may drive the vehicle, but do not exceed 8 hours of operation until after the engine has been inspected and the LongMile-S has been serviced by an ESW CleanTech authorized technician. Operator should continue to monitor the status of the lights for instruction.

Green Light Flashing

A flashing green light indicates that the LongMile-S is approaching its backpressure threshold. The driver should reduce the load on the engine if that is possible with the current driving conditions. If the driver's actions successfully result in the backpressure dropping below its threshold for a period of time, the green light will automatically stop flashing. If the green light stops flashing, the driver may resume normal operations.

Also avoid continuous idle anytime the green (or amber) light is flashing. If the engine has been idling for more than 1 minute, ESW CleanTech recommends turning it off. Continuing to idle while the green (or amber) light is flashing could allow an uncontrolled regeneration and/or cause damage to the LongMile-S.

Possible causes of the flashing green light are given in the list below. Consult an ESW CleanTech authorized distributor as needed.

- DPF is capturing soot at a higher-than-expected soot loading, possibly caused by:
    - Improper or contaminated fuel
    - Engine malfunction (such as leaky injectors or blown turbo)
    - Extended idle time followed by appreciable high-load operation
- DPF is approaching its ash removal requirement (cleaning will be required)

Amber Light Flashing

A flashing amber light indicates that the LongMile-S is causing backpressure above its threshold. The driver should reduce the load on the engine if that is possible with the current driving conditions. Contact a ESW CleanTech authorized distributor for service. The DPF may need cleaning. Do not exceed 8 hours of engine run time without express approval from an ESW CleanTech authorized distributor.

If the high backpressure condition is temporary, the amber LED will automatically stop flashing once the backpressure drops below the threshold for a period of time.

Amber Light on Solid

A solid amber light indicates a broken sensor, disconnected sensor or system fault. Contact a ESW CleanTech authorized distributor (or a properly trained technician under the owner's control) as soon as practical. Do not exceed 8 hours of engine run time without express approval from an ESW CleanTech authorized distributor.

ATTENTION:

If the amber light is solid, service is required.

Verify that all the wiring harness connections are properly attached. If the amber light stays on, have the system serviced as soon as possible. For some faults, the solid amber light can only be turned off by connecting the service computer to the MLC and performing software operations with the *MLinC* program.

The amber light will turn on solid for a few seconds after the engine is started and put under load. This allows the operator to confirm that the LED itself is good.

Conditions That May Damage the LongMile-S

The operator should be aware of conditions that could result in damage or failure of the PM filter assembly or other parts of the system. If any of these events occur, it is the owner's responsibility to have the LongMile-S inspected and, if necessary, repaired.

See the owner's legal requirements under the Clean Air Act and CARB regulations in the "Owner's Legal Obligations" section on page 2.

Mechanical damage can occur if any system component is mishandled or accidentally impacted. Internal damage to the PM filter assembly can occur from various forms of engine failure such as losing a turbo or head gasket. These events would cause foreign debris to enter the exhaust gas and then impact the PM filter assembly, likely causing some damage. Furthermore, losing a turbo, a failed injector, or a major oil leak could result in excessively high temperatures in the PM filter assembly. If the engine loses the turbo, the operator should move the vehicle to a safe location as soon as possible and shut the engine off.

Excessive idle can cause a buildup of soot in the DPF which could lead to excessive temperatures in the DPF during higher load operations resulting in damage to the DPF. If the engine has been idling for more than 5 minutes, turn it off. Extended idle may lead to damage of the LongMile-S and may be the basis for denying a warranty claim.

Engine oil consumption has an impact on the operation and maintenance of the LongMile-S. If engine oil consumption exceeds the engine manufacturer's specification, the engine should be repaired. Failure to do so may damage the LongMile-S and may be the basis for denying a warranty claim. High oil consumption will increase the rate of ash accumulation in the DPF and will lead to more frequent maintenance. The "Engine Oil Consumption and Lube Oil Ash" section on page 22 explains the impacts of oil consumption and ash content on the operations and maintenance of the system.

Power washing the vehicle should not be a problem for the PM filter assembly. Avoid pointing the high-power wash at any LongMile-S system components or connectors. However, depending on the power washing technique, it may be possible to loosen an electrical connector. If a connector comes loose, the amber light might turn on. If the amber light comes on, follow the procedures in the Troubleshooting Table (page 20).

Turn out stacks or rain caps are required on vertical stacks to avoid water intrusion. Be sure the turn out or rain cap is in place and functioning properly. It is important that water does not enter the exhaust pipe where it could migrate to the PM filter assembly. Avoid low hanging branches or other obstacles that could knock off the rain cap.

MAINTENANCE AND REPAIR

Your Right to Maintenance Information

The Air Resources Board requires that ESW CleanTech provide detailed maintenance information for the diesel emission control system upon delivery to the end-user pursuant to section 2706(h)(2), Title 13, California Code of Regulations, at no additional cost to the owner. If you do not already have this information, contact ESW CleanTech at 1-800-398-6105.

The Importance of Engine Maintenance

Proper engine maintenance is critical for the proper functioning of your diesel emission control strategy. Failure to document proper engine maintenance, including oil consumption records, may be grounds for denial of a warranty claim for a failed component of a diesel emission control strategy.

The Importance of Properly Maintaining a Diesel Emission Control Strategy

Proper maintenance is critical for the diesel emission control strategy to function as intended. Failure to document proper diesel emission control strategy maintenance, including cleaning and/or ash removal of the system, replacement of consumables, and replacement of broken/failed parts, may be grounds for denial of a warranty claim for a failed component of a diesel emission control strategy.

Maintenance Schedule

ESW CleanTech recommends that a ESW CleanTech authorized technician or a properly trained technician under the owner's control perform the maintenance and repair of a LongMile-S. Preventative maintenance is required once a year, every 2,000 operating hours, or every 50,000 miles (whichever comes first) to ensure that the system is maintained in good operating condition; however, the DPF may require cleaning more often than that depending on the engine's oil consumption rate. See the "Engine Oil Consumption and Lube Oil Ash" section on page 22 for more information.

The owner is legally required to keep the LongMile-S in good operating condition in order to comply with the Clean Air Act and CARB regulations (for systems operating in California). See the "Owner's Legal Obligations" section on page 2.

Failure to have the preventative maintenance performed may be the basis for denying a warranty claim. Maintenance or repairs done by anyone other than an ESW CleanTech authorized technician is the responsibility of the person or organization performing the work.

The cost of parts and labor for preventative maintenance are not included in the purchase price of the LongMile-S system. The parts and labor included in preventative maintenance are listed in the "Preventative Maintenance Labor and Parts" section below.

Preventative Maintenance Labor and Parts

The preventative maintenance by an ESW CleanTech authorized technician includes:

- Inspect the Controls Box and components.
- Download data from the MLC and review the Instant Report.
- Confirm the driver notification lights are functioning properly.
- Inspect the BP sensor and sensor breather. Clean out BP tubing and ports.
- Inspect all components of the PM filter assembly and clean the DPF.
- Inspect exhaust tubing.
- Reinstall the PM filter assembly and confirm it is properly mounted.
- Inspect the sensors and wiring harness.
- Upgrade the MLC program if necessary.
- Check CARB-verification labels.
- Make repairs (if any of the above inspections showed repairs are needed).
- Perform comprehensive tests of the system's operations.

DPF Maintenance

It may be necessary to periodically clean the DPF (in addition to the cleaning during preventative maintenance) depending on the engine's duty cycle and the ash content of the diesel fuel and lube oil. The collection of inorganic ash results in an increase in backpressure from the DPF over time. If ash in the DPF results in high backpressure, then the green or amber lights will flash. Note: higher than normal oil consumption will increase the rate of ash accumulation in the DPF, and thus may require more frequent maintenance.

ESW CleanTech recommends the use of low-ash engine oils (CJ-4 oil). These products have been specifically designed for use with diesel particulate filters, and can significantly reduce the buildup of ash in the DPF and extend the filter cleaning interval. See the "Engine Oil Consumption and Lube Oil Ash" section on page 22. ESW CleanTech recommends cleaning the DPF according to the engine oil consumption table below.

Cleaning Interval Based on Engine Oil Consumption and DPF Part

Oil Type	CJF-___-LM	CKF-___-LM	CNF-___-LM	CPF-___-LM
CJ-4	24 quarts	28 quarts	31 quarts	40 quarts
CI-4	16 quarts	18 quarts	21 quarts	26 quarts

A ESW CleanTech authorized distributor can clean the DPF. They also will ensure that the collected material (ash and soot) is properly disposed in accordance with all applicable Federal, State and local laws governing waste disposal.

The DPF is unidirectional and it processes exhaust flow in only one direction. If the DPF is removed for cleaning, it may only be reinstalled in the proper flow direction because the inlet and outlet flanges are different sizes. There is also a flow arrow on the part tag (see Figure 6 on page 19).

Exhaust Tubing and Components

All tubing connections between the engine and the PM filter assembly should be gas-tight and leak-free. Also, all tubing between the engine and PM filter assembly must be in good condition. This requirement includes any other components such as exhaust brakes. Aluminized mild steel tubing or rusty tubing could flake off into the exhaust stream. If flaking occurs, the DOC or DPF may plug, resulting in high backpressure and engine power loss. ESW CleanTech recommends using stainless steel tubing between the turbo and the PM filter assembly. **It is the engine owner or operator's responsibility to ensure that all tubing in this critical area be maintained in good condition.**

Service Calls

The MLC controls the green and amber indicator lights to provide system status as described in the "Driver Notification Lights" section (page 11). However, not all conditions will be detected by the MLC (for example, a traffic accident that physically damages the PM filter assembly). Therefore, it is important that the owner and/or operator routinely observe the engine and LongMile-S operations in addition to watching the driver notification lights. See the "Operations" section (page 10) for routine observations that the operator and/or owner should perform and the "Owner's Obligations" section on page 25.

Upon any indication of a malfunction, promptly contact an ESW CleanTech authorized distributor (or the owner's technician). See the "Contact Information" section on page 3. Please be prepared with the following information:

1. Fault information and descriptions in as much detail as possible.
2. The Verification Tag number (see Figure 3 and Figure 4)
3. The data plate part numbers and serial numbers (see Figure 6 and Figure 7).

Figure 6: DPF part tag and flow arrow.

Figure 7: DOC part tag.

Parts List

A complete parts list was provided with the system. Contact your ESW CleanTech authorized distributor if you need a replacement list. The major parts are listed in the table below.

LongMile-S System Major Parts List

Item #	Qty	Part Number	Description
1	1	C_F-___-LM	Diesel Particulate Filter Assembly, Unidirectional
2	1	CJD-20-10, CJDA-20-10, CJD-27-10, CJDA-27-10, CJD-35-10 or CJD-33-10	Diesel Oxidation Catalyst (DOC)
3	2	CMA-4	Sensor, Thermocouple
4	1	CMKC-5.0__ , CMKC-6.0__ , CMKM-5.0__ , or CMKM-6.0__	MLC (electronic control unit)
5	1	CUE-45	Sensor, Backpressure
6	1	CJ___-_-AP___	Cone, inlet
7	1	C____-_	Cone, outlet (as applicable)
8	1	CUE-300	LED, Green
9	1	CUE-301	LED, Amber
10	1	CUH-886-1	Label, LED, LongMile-S

Spaces represent variables depending on specific configuration and application.

Troubleshooting Table

Use the table below to diagnose and resolve potential LongMile-S operating problems. See the "Driver Notification Lights" section on page 11 for additional information.

Condition	Probable Cause	Remedy
1. Green light off (while engine is on)	• No power to the MLC • Loss of MLC program (if amber on and green off) • Faulty light or wiring	• Check fuse, wires and power source (battery). • Contact an ESW CleanTech authorized distributor for repair.
2. Unusual exhaust noises	• Loose tubing connection(s) • Loose clamp(s) • Crack in exhaust tube • Crack in the DPF • Engine turbo problem	• Tighten connection(s). • Replace damaged tube. • Contact an ESW CleanTech authorized distributor for repair.
3. White smoke during startup	• Normal condensation inside the DPF	• No action required.
4. Light soot dusting in exhaust tube	• Normal condition	• No action required.
5. Visible emissions (white or black smoke during normal operations)	• Engine problem resulting in oil or coolant loss • DPF failure • Normal at first start up after cleaning	• Contact an ESW CleanTech authorized distributor for repair. • None required (if only visible at first start up after cleaning).
6. Engine surges or has power loss	• Engine malfunction (most likely cause) • Overloaded DPF (green light will have been flashing for some time if this is the cause of engine surging or low power)	• Repair the engine. • If the engine passes all its diagnostic tests, then contact an ESW CleanTech authorized distributor for service. (DPF will likely need cleaning.)

There is additional troubleshooting information in the LongMile-S Service Manual. This manual is for trained technicians.

Repair and Maintenance Clarifications

The warranty (page 27) includes a section titled “Owner’s Warranty Responsibility” which clarifies that the owner or operator is responsible for making sure that the maintenance described in this owner’s manual is performed. In addition to the scheduled preventative maintenance, the solid amber light is another indicator that maintenance or repair is required.

ATTENTION:

The solid amber light indicates that service is required.

Cleaning the DPF is a maintenance item and is not covered under warranty. If a repair is required, it may be covered under the installation or product warranty depending on the cause.

The table below provides a summary of service types (maintenance or repair) and what organization is responsible for the cost of the service.

Service Type (and subtype)		**Definition/Example**	**Cost Responsibility**
Maintenance	(unplanned)	High backpressure from DPF overloaded with ash.	Owner
	(regularly planned)	High backpressure from DPF overloaded with ash.	Owner
	(comprehensive preventative maintenance)	Clean out ash from the DPF. Perform multi-step complete system check out.	Owner
Repair	(warrantable)	System or component fails in normal application.	ESW CleanTech
	(warrantable)	System or component failed because it was installed improperly.	Installer
	(non-warrantable)	System or component damaged through abuse, neglect, or misapplication. Warranty period has lapsed.	Owner

Engine Oil Consumption and Lube Oil Ash

DPFs are designed to capture all solid particles coming from the tailpipe. While most of the captured material can be readily regenerated (oxidized) inside the filter, the DPF will accumulate incombustible materials, collectively called “ash,” which cannot be regenerated and must be removed through offline cleaning.

The majority of the ash comes directly from oil consumed during engine operation, though small amounts of ash also come from the fuel and engine wear. Most of the ash that accumulates in the DPF is part of the lube oil additive package, and since the DPF will capture all solid materials coming from the engine exhaust, all the ash from oil consumption will ultimately end up in the DPF. Thus, the ash content of the lube oil and the oil consumption rate become critical factors in determining the rate of ash accumulation in the filter.

Pre-2007, CI-4 oil typically contains between 1.2 and 1.5% ash by weight. The new CJ-4 oils, designed especially for diesel engines with diesel particulate filters, contain approximately 1.0% ash, and will therefore result in a lower filter loading for a given amount of oil consumption. ESW CleanTech recommends cleaning the DPF according to the engine oil consumption table below.

Cleaning Interval Based on Engine Oil Consumption and DPF Part

Oil Type	CJF-___-LM	CKF-___-LM	CNF-___-LM	CPF-___-LM
CJ-4	24 quarts	28 quarts	31 quarts	40 quarts
CI-4	16 quarts	18 quarts	21 quarts	26 quarts

Factors like engine duty cycle, soot composition, ash composition and others can also have an impact on the filter cleaning interval. Furthermore, if there are long periods of operation where the engine does not meet the temperature requirements for regeneration or if there are excessive soot emissions (from a failed injector for example), the filter may need to be cleaned more often. Customers can extend their filter cleaning interval by:

- Maintaining their engines to minimize oil consumption
- Switching to low ash oils

SPECIFICATIONS

LongMile-S System	
PM Filter Assembly Weight	125 to 150 pounds
Materials of Construction	304 stainless steel
Diesel Fuel Type (same as engine fuel)	Any diesel fuel allowed for in the LongMile-S verification

ESW CleanTech MLC	
Voltage	12 V or 24V nominal
Real time clock	Battery-backed
Diagnostic and Programming I/O	9-pin DBF Serial (RS-232) (adapter from harness required)
Inputs	
PM filter assembly Inlet Temperature	Type K thermocouple, ungrounded
PM filter assembly Outlet Temperature	Type K thermocouple, ungrounded
Engine Electrical Power (Battery Voltage)	12 VDC or 24 VDC nominal
PM filter assembly Backpressure Sensor	0 – 5 VDC
Outputs	
Two Power Output Lines	5 VDC
Two Driver Notification Lights	Green and amber lights (LEDs)

OWNER'S OBLIGATIONS

The owner's actions in the following table are mandatory for proper system operation. Failure to do the required action(s) could be the basis for denying a warranty claim or a fine by CARB. **Furthermore, failure to adhere to these instructions could result in damage or failure to the LongMile-S system.**

Event or Symptom	Owner's Action Item	Manual Section
Initial installation of LongMile-S system.	Review this manual and know the requirements for the LongMile-S system. Be sure that operators and maintenance staff understand each item in the "Operations" section.	This entire manual. "Operations" (page 10).
Flashing amber light (DPF may need cleaning)	Contact a ESW CleanTech authorized distributor or a properly trained technician to investigate the cause of the flashing amber light and clean the DPF if needed.	"Driver Notification Lights" (page 11).
Solid amber light (bad sensor or system fault).	Contact a properly trained technician to service the LongMile-S as soon as possible. Do not allow the engine to exceed 8 hours of run time.	"Driver Notification Lights" (page 11).
Engine malfunction (such as turbo failure, injector failure, excess oil consumption, or leaky head gasket).	If the turbo fails, park in a safe place ASAP and shut the engine off. Contact a properly trained technician promptly. (System components may be damaged from foreign material.)	"Conditions That May Damage the LongMile-S" (page 14).
Debris or other object impacts LongMile-S system or components.	Contact a properly trained technician promptly since system components may be damaged, including hidden damage to internal components.	"PM Filter Assembly" (page 6) and "Conditions That May Damage the LongMile-S" (page 14).
Tubing or exhaust component between the engine and the PM filter assembly is removed, replaced or in poor condition.	Ensure that the tubing or component is installed properly and that no debris could enter the exhaust stream. (Debris or foreign matter in the exhaust stream can damage the PM filter assembly or system components. Also, exhaust leaks may result in poor system performance and safety hazards.)	"Exhaust Tubing and Components" (page 18).
For a vertical exhaust stack, the rain cap or turn out stack is knocked off or somehow missing.	Replace the rain cap or turn out stack as soon as practical. If any water entered the exhaust pipe then contact a properly trained technician.	"PM Filter Assembly" (page 6) and "Conditions That May Damage the LongMile-S" (page 14).
Oil consumption is more than the engine manufacturer's specification.	Monitor and keep accurate records of the engine's oil consumption rate. If oil consumption exceeds the specification, repair the engine so that oil consumption is within the manufacturer's specification.	"Conditions That May Damage the LongMile-S" (page 14) and "Engine Oil Consumption and Lube Oil Ash" (p. 22).
Engine has been idling for more than 5 minutes.	Turn the engine off.	"Cautions" (page 2), "Operations" (page 10), and "Conditions That May Damage the LongMile-S" (page 14).

WARRANTY

Product Warranty

YOUR WARRANTY RIGHTS AND OBLIGATIONS

ESW CleanTech, Inc. (ESW CleanTech) warrants the diesel emission control system in the application for which it is sold or leased to be free from defects in design, materials, workmanship, or operation of the diesel emission control system which cause the diesel emission control system to fail to conform to the emission control performance level it was verified to, or to the requirements in the California Code of Regulations, Title 13, Sections 2700 to 2706, and 2710, for the periods of time listed in Table 1, provided there has been no abuse, neglect, or improper maintenance of your diesel emission control system, vehicle or equipment, as specified in the owner's manuals. Where a warrantable condition exists, this warranty also covers the engine from damage caused by the diesel emission control system, subject to the same exclusions for abuse, neglect or improper maintenance of your vehicle or equipment. Please review your owner's manual for other warranty information. Your diesel emission control system may include a core part (e.g., particulate filter, diesel oxidation catalyst, selective catalytic reduction converter) as well as hoses, connectors, a back pressure monitor (if applicable), and other emission-related assemblies. Where a warrantable condition exists, ESW CleanTech will repair or replace your diesel emission control system at no cost to you including diagnosis, parts, and labor.

Table 1: Warranty Period

Engine Type	Engine Size	Warranty Period
On-Road	Light heavy-duty, 70 to 170 hp, Gross Vehicle Weight Rating (GVWR) less than 19,500 lbs.	5 years or 150,000 miles
	Medium heavy-duty, 170 to 250 hp, GVWR from 19,500 lbs. to 33,000 lbs.	
	Heavy heavy-duty, exceeds 250 hp, GVWR exceeds 33,000 lbs.	
	Heavy heavy-duty, exceeds 250 hp, GVWR exceeds 33,000 lbs., and the truck is: 1. Typically driven over 100,000 miles per year, and 2. Has less than 300,000 miles on the odometer at the time of installation.	2 years, unlimited miles
Off-Road (includes portable engines), Stationary, Marine, Locomotives, TRU and APU	Under 25 hp, and for constant speed engines rated under 50 hp with rated speeds greater than or equal to 3,000 rpm	3 years or 1,600 hours
	At or above 25 hp and under 50 hp	4 years or 2,600 hours
	At or above 50 hp	5 years or 4,200 hours

WARRANTY COVERAGE

For an engine used in an application listed in Table 1, the warranty period will be the years or hours or miles of operation shown in Table 1, whichever occurs first. If any emission-related part of your diesel emission control system is defective in design, materials, workmanship, or operation of the diesel emission control system thus causing the diesel emission control system to fail to conform to the emission control performance level it was verified to, or to the requirements in the California Code of Regulations, Title 13, Sections 2700 to 2706, and 2710, within the warranty period, as defined above, ESW CleanTech will repair or replace the diesel emission control system, including parts and labor.

In addition, ESW CleanTech will replace or repair the engine components to the condition they were in prior to the failure, including parts and labor, for damage to the engine proximately caused by the verified diesel emission control strategy. This also includes those relevant diagnostic expenses in the case in which a warranty claim is valid. ESW CleanTech may, at its option, instead pay the fair market value of the engine prior to the time the failure occurs.

OWNER'S WARRANTY RESPONSIBILITY

As the vehicle, engine, or equipment owner, you are responsible for performing the required maintenance described in your owner's manual. ESW CleanTech recommends that you retain all maintenance records and receipts for maintenance expenses for your vehicle, engine, or equipment, and diesel emission control system. If you do not keep your receipts or fail to perform all scheduled maintenance, ESW CleanTech may have grounds to deny warranty coverage. You are responsible for presenting your vehicle, equipment, or engine, and diesel emission control system to an ESW CleanTech distributor as soon as a problem is detected. The warranty repair or replacement should be completed in a reasonable amount of time, not to exceed 30 days. If a replacement is needed, this may be extended to 90 days should a replacement not be available, but must be performed as soon as a replacement becomes available.

If you have questions regarding your warranty rights and responsibilities, you should contact ESW CleanTech at 1-800-398-6105 or the California Air Resources Board at 9528 Telstar Avenue, El Monte, California 91731, or (800) 363-7664, or electronic mail: helpline@arb.ca.gov.

Installation Warranty

YOUR WARRANTY RIGHTS AND OBLIGATIONS

The installer must warrant that the installation of a diesel emission control system is free from defects in workmanship or materials which cause the diesel emission control system to fail to conform to the emission control performance level it was verified to, or to the requirements in the California Code of Regulations, Title 13, Sections 2700 to 2706. The warranty period and the extent of the warranty coverage provided by the installer must be the same as the warranty provided by ESW CleanTech and the same exclusions apply.

OWNER'S WARRANTY RESPONSIBILITY

As the vehicle, engine, or equipment owner, you are responsible for presenting your vehicle, engine, or equipment, and diesel emission control system to the installer as soon as a problem with the installation is detected.

If you have questions regarding your warranty rights and responsibilities, you should contact the installer or ESW CleanTech at 1-800-398-6105 or the California Air Resources Board at 9528 Telstar Avenue, El Monte, California 91731, or (800) 363-7664, or electronic mail: helpline@arb.ca.gov.

ESW CleanTech, Inc. Warranty Clarifications

(Which do not limit or modify the provisions of the Product Warranty or Installation Warranty in any way)

The product warranty above is the sole warranty made by ESW CleanTech. There are no other warranties, expressed or implied, of merchantability or fitness for a particular purpose.

For the purpose of the product warranty and installation warranty, abuse or neglect includes vehicle accidents, ignoring the driver notification lights, blending lubricating oil with fuel, or any engine failure or condition that are not proximately caused by the diesel emission control system that allows excess lubricating oil, coolant, contaminants or debris to enter the exhaust system. The owner shall not use any fuel additive or lube oil additive that is not approved by EPA or CARB for use in diesel engines equipped with catalytic mufflers.

ESW CleanTech recommends that the verified diesel emissions control strategy be installed and serviced by ESW CleanTech authorized personnel. Improper installation or service by unauthorized or untrained personnel may result in a denial of coverage under the product warranty or installation warranty.

CARB EXECUTIVE ORDER FOR THE LONGMILE-S

State of California
AIR RESOURCES BOARD

EXECUTIVE ORDER DE-12-007-01

The diesel emission control strategy described herein qualifies as a potential compliance option for the Air Resources Board's (ARB) in-use diesel fleet rules.

Pursuant to the authority vested in ARB by the *Health and Safety Code*, Division 26, Part 5, Chapter 2; and pursuant to the authority vested in the undersigned by *Health and Safety Code* Sections 39515 and 39516 and Executive Order G-02-003;

Relating to Exemptions under Section 27156 of the *Vehicle Code*, and Verification under Sections 2700 to 2711 of Title 13 of the *California Code of Regulations* (CCR)

ESW CleanTech, Incorporated (ESW CleanTech)
LongMile-S Diesel Particulate Filter System (LongMile-S)

ARB has reviewed ESW CleanTech's request for verification of the LongMile-S system. Based on an evaluation of the data provided, and pursuant to the terms and conditions specified below, the Executive Officer of ARB hereby finds that the LongMile-S system reduces emissions of diesel particulate matter (PM) consistent with a Level 3 device (greater than or equal to 85 percent reductions) (Title 13, CCR, Sections 2702(f) and 2708) and is compliant with the 2009 nitrogen dioxide emissions limit. Accordingly, the Executive Officer determines that the system merits verification and, subject to the terms and conditions specified below, classifies the LongMile-S system as a Level 3 Plus system for heavy-duty on-road vehicles that use certain heavy-duty engines. Engines for which the LongMile-S system is verified, the verified parts list, the verified labels, swapping and re-designation information, and other product information can be found here:

http://www.arb.ca.gov/diesel/verdev/companies/esw/longmile-s.htm.

The aforementioned verification is subject to the following terms and conditions:

- The engine must be originally manufactured from model year 1993 through 2010.
- The engine must be used by an on-road motor vehicle with a manufacturer's Gross Vehicle Weight Rating of over 14,000 pounds.
- The engine must be certified for on-road applications.

- The application must have a duty cycle with an exhaust temperature profile that meets either of the two criteria below:
    - Greater than 260 degrees Celsius for at least 25 percent of the time, or
    - Greater than 260 degrees Celsius for at least 20 percent of the time, and greater than 300 degrees Celsius for at least 5 percent of the time.
- The engine's displacement must not exceed 15 liters.
- The engine must have a power rating of at least 175 horsepower and at most 500 horsepower.
- Only one filter may be installed per engine.
- The engine must be in its original certified configuration.
- For model years 1994 and newer, the engine must have a PM certification level of at most 0.1 grams per brake horsepower-hour (g/bhp-hr), and greater than 0.01 g/bhp-hr.
- The engine may be certified to have exhaust gas recirculation.
- The engine may be certified to have a pre-existing original equipment manufacturer (OEM) diesel oxidation catalyst (DOC). The DOC may be removed to facilitate installation of the LongMile-S system.
- The engine must not be certified to have an OEM diesel particulate filter (DPF).
- The engine must have a four-stroke combustion cycle.
- The engine must be turbocharged.
- The engine may be mechanically or electronically controlled.
- The engine must be well maintained and not consume lubricating oil at a rate greater than that specified by the engine manufacturer.
- Lube oil, or other oil, must not be mixed with the fuel.
- The engine must be operated on fuel that has a sulfur content of no more than 15 parts per million by weight.
- The system must not be operated with fuel additives, as defined in Section 2701 of Title 13, of the CCR, unless explicitly verified for use with fuel additive(s).

- The system must not be used with any other systems or engine modifications without ARB and manufacturer approval.

- The system must be installed with a backpressure monitor to notify the operator when the backpressure limit is reached. The notification must occur and be clearly visible to the operator while the vehicle or equipment is in use.

- The other terms and conditions specified below.

IT IS ALSO ORDERED AND RESOLVED: That installation of the LongMile-S system, manufactured by ESW CleanTech, 6755 Mira Mesa Boulevard, Suite 123-122, San Diego, California 92121, has been found not to reduce the effectiveness of the applicable vehicle pollution control system, and therefore the LongMile-S system is exempt from the prohibitions in Section 27156 of the *Vehicle Code* for installation on heavy-duty on-road vehicles. This exemption is only valid provided the engines meet the aforementioned conditions.

ARB reserves the right in the future to review this Executive Order and the exemption and verification provided herein to assure that the exempted and verified add-on or modified part continues to meet the standards and procedures of CCR, Title 13, Section 2222, et seq, and CCR, Title 13, Sections 2700 through 2711.

The LongMile-S system consists of the following major system components, listed in order from exhaust inlet to outlet as they are arranged within the exhaust system of the vehicle: one inlet cone, one DOC, one silicon carbide wall-flow DPF, and one outlet cone. The LongMile-S system also includes a backpressure monitor and warning system. The major components of the LongMile-S system are identified in the parts list. The parts list and schematics of the approved product and engine labels are available on the website shown above.

The LongMile-S system is comprised of a single silicon carbide wall-flow DPF designed to filter the exhaust from a single engine. LongMile-S systems with multiple DPFs, including designs with two or more filter components canned together or multiple individually-canned filter components in parallel or in series (or any combination thereof), are not valid under this Executive Order. Channeling exhaust from a single engine through multiple LongMile-S systems, deployed in parallel or in series or any combination thereof, is also not valid under this Executive Order.

No changes are permitted to the system. ARB must be notified, in writing, of any changes to any part of the LongMile-S system. Any changes to the system must be evaluated and approved in writing by ARB. Failure to do so shall invalidate this Executive Order.

ESW CleanTech must ensure that the installation of the LongMile-S system conforms to all applicable industrial safety requirements.

Changes made to the design or operating conditions of the LongMile-S system, as exempted by ARB, which adversely affect the performance of the vehicle's pollution control system, shall invalidate this Executive Order.

This Executive Order is valid provided that installation instructions for the LongMile-S system do not recommend tuning the vehicle to specifications different from those of the vehicle manufacturer.

Marketing of the LongMile-S system using identification other than that shown in this Executive Order or for an application other than that listed in this Executive Order shall be prohibited unless prior written approval is obtained from ARB.

This Executive Order shall not apply to any LongMile-S system advertised, offered for sale, sold with, or installed on a motor vehicle prior to or concurrent with transfer to an ultimate purchaser.

A copy of this Executive Order must be provided to the ultimate purchaser at the time of sale.

As specified in Section 2706 (j) (Title 13, CCR) of the *Verification Procedure, Warranty, and In-Use Compliance Requirements for In-Use Strategies to Control Emissions from Diesel Engines* (Procedure), ARB assigns each diesel emission control strategy a family name. The designated family name for the verification as outlined above is:

CA/ECT/2012/PM3+/N00/ON/DPF01

The designated family name CA/ECT/2012/PM3+/N00/ON/DPF01 replaces the previous name CA/CLE/2012/PM3+/N00/ON/DPF01.

As stated in the Procedure, ESW CleanTech is responsible for recordkeeping requirements (Section 2702), honoring the required warranty (Section 2707), and conducting in-use compliance testing (Section 2709).

Proper engine maintenance is critical for the proper functioning of the diesel emission control strategy. The owner of the vehicle on which the diesel emission control strategy is installed is strongly advised to adhere to all good engine maintenance practices. Failure to document proper engine maintenance, including keeping records of the engine's oil consumption, may be grounds for denial of a warranty claim.

Use of system parts or replacement parts not authorized by ESW CleanTech may be grounds for denial of a warranty claim.

This Executive Order is valid provided that the diesel fuel used in conjunction with the system complies with Title 13, CCR, Sections 2281 and 2282, and if biodiesel is used, the biodiesel blend shall be 20 percent or less subject to the following conditions:

- The biodiesel portion of the blend complies with the American Society for Testing and Materials specification D6751 applicable for 15 parts per million sulfur content.
- The diesel fuel portion of the blend complies with Title 13, CCR, Sections 2281 and 2282.

Other alternative diesel fuels such as, but not limited to, ethanol diesel blends and water emulsified diesel fuel are excluded from this Executive Order.

The LongMile-S system must not be located over any occupied space (e.g., driver or passenger compartments), or installed in a way which would result in noncompliance with any applicable safety standards including but not limited to Federal Motor Carrier Safety Administration, Subpart G, *Miscellaneous Parts and Accessories*, Section 393.83 *Exhaust Systems*, and any other location deemed unacceptable by ESW CleanTech.

Systems verified under this Executive Order shall conform to all applicable California emissions regulations.

The terms and conditions of this Executive Order must be satisfied regardless of where the system is sold in order for the system to be considered verified.

Systems sold as verified, or which carry the ARB-approved label, must satisfy all the terms and conditions of this Executive Order.

This Executive Order does not release ESW CleanTech from complying with all other applicable regulations.

Violation of any of the above conditions shall be grounds for revocation of this Executive Order.

This Executive Order hereby supersedes Executive Order DE-12-007 (dated December 7, 2012).

Executed at El Monte, California, and effective this 16th day of May 2013.

Annette Hebert, Chief
Mobile Source Control Division

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